

Genus ANOPHELES Meigen.

Anopheles quadrimaculatus Say.

Through the kindness of Dr. A. Handlirsch of the Vienna Museum, Dr. C. von Kertész of the Hungarian National Museum, Prof. R. Blanchard of the Faculty of Medicine of Paris and Mr. F. V. Theobald, we have become possessed of a number of specimens of the European *Anopheles maculipennis* Meig. These abundantly establish our contention of the distinctness of this form from any of the American species. *Maculipennis* is nearer to the Californian *occidentalis* D. & K. than to the Eastern *quadrimaculatus* Say, but lacks the apical yellowish wing spot characteristic of *occidentalis*.

Genus CULEX Linnæus.

Culex toweri, new species.

Head behind the eyes margined with silvery gray; thorax clothed with rather pale yellowish brown scales above with faint traces of dorsal stripes; abdomen entirely black above, beneath with white lateral basal spots and a pale median area. Wings with the veins and fringe dark brown scaled. Hind legs black with the first to fourth tarsal joints narrowly white ringed at both ends, fifth joint white ringed at the base; knees white tipped, tibiæ rather broadly white tipped; on the first and second pairs of legs the annulations are much reduced. Proboscis and palpi black.

39 specimens, Mayaguez, Porto Rico (W. V. Tower).

Type. — Cat. no. 10222, U. S. Nat. Mus.

The larva falls with *Culex lamentator* D. & K. in the table and is much like it, but the adults are quite distinct.

Culex fur, new species.

Proboscis black; head broad, black behind the eyes; thorax with the anterior half covered with brassy scales, two large dark patches within this area on the disk before; posterior half of the thorax deep brown. Abdomen black above, the hind margins of the segments with yellowish hairs; beneath dirty gray. Legs black. Wings brown scaled along the veins, the scales on the apical portion broad. Tarsal claws simple.

One specimen, ♀, Colon, Panama (A. C. H. Russell).

Type. — Cat. no. 10259, U. S. Nat. Mus.

The larva is unknown to us.

AN EARLY ACCOUNT OF THE COPULATION OF STEGOMYIA CALOPUS.

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In the third volume of the *Mémoires de Mathématique et de Physique*, published in 1760, the French commander Godeheu de

Riville gives an enthusiastic and detailed account of his observations on the copulation of mosquitoes. He puts the facts on record in the belief that his was the first observation of the kind. However the *Acta* of the old Leopold-Carolinan Academy in 1737 contained a notice of the copulation of mosquitoes by the Spaniard Diego Reviglias, communicated in a letter dated 4 March, 1728.

The account of Reviglias is mainly directed towards refuting the then generally accepted doctrine that insects did not reproduce themselves but were the product of processes of decomposition. A pair of mosquitoes found united formed the basis of this essay and the mode of copulation and the structure of the male and female genitalia are carefully described. However nothing is said of the mating habits and at present the article has little more than an historical interest. Incidentally it may be noted that the mosquito-pair was kept under a glass until they died and for some time thereafter. A small hairy "worm," doubtless a dermestid larva, subsequently made its appearance and was concluded to be the product of the union of the mosquitoes.

The account of Godeheu de Riville gains especial interest at present in that, through seemingly trivial details, we are able to identify the mosquito he had under observation, with, I may say, positive certainty. To the uninitiated this assertion will appear quite incredible; yet, with the data on the copulation of mosquitoes that we now have at hand, the species in question can be pointed out with assurance as *Stegomyia calopus*. I will first give in short the essentials of Godeheu de Riville's account and then point out the grounds upon which I base my conclusions.

Godeheu de Riville, on a return voyage from India, directed his efforts to the discovery of the copulation of mosquitoes, and he relates how his persistent efforts were at last successful. He dwells upon the conditions, exceptionally favorable to his purpose, which existed on board the ship on leaving Pondichery. The water brought on board at Pondichery swarmed with the larvæ and pupæ of mosquitoes but these all perished when the casks were sealed. Nevertheless a goodly number of mosquitoes survived in certain earthen jars in which drinking water was kept to preserve it in good condition. During the first three weeks, whenever the cover of one of these jars was lifted, a cloud of mosquitoes made its escape. The great number of mosquitoes present on board during the first few weeks after departure from Pon-

dichery and the small area to which they were restricted led the commander to believe that the conditions were exceptionally favorable for accurate observation of their behavior. The warm climate and the abundance of "heating" food, he reasoned, should produce a stimulating effect upon the reproductive functions, and in consequence copulation should be more frequent and the opportunities for observation increased. On account of its small size the state-room seemed favorable for this purpose and the first three hours after noon, when the mosquitoes seemed most active, were selected as the most favorable time. The windows were closed against the wind, and after a sufficient number of mosquitoes had entered, the door was likewise closed. Thereupon the commander, his legs and hands well protected, and armed with a feather to drive off the mosquitoes that threatened his face, spent more than an hour each day in the close heat of his cabin, attentively watching the cloud of mosquitoes which surrounded him. In spite of the time spent nothing was discovered but the pursuit by the male, which was so much like that in butterflies (as described by Réaumur) that the commander did not consider it worth recording. Convinced that in the end his efforts would be successful he persisted in his observations. He became discouraged, however, when the ship fell into the cold winds off the Cape of Good Hope. The mosquitoes abandoned all the upper part of the ship and fled between decks for shelter, there to suck blood at will.

Shortly after the Cape had been doubled they reappeared again with the good weather. They all looked well nourished and all that were crushed were found to be filled with blood. The commander thereupon resumed his observations, encouraged further by having found females with the abdomen filled with white bodies which, under a strong lens, he recognized as eggs. These observations proved more decisive than the previous ones. He distinctly saw, flying past him, many couples of mosquitoes intimately united but in a manner different from that in other flies. Their flight slackened at intervals, when it could be seen that they were united face to face, their legs intertwined. From time to time couples fell upon the bureau and again took flight. Many couples that the commander crushed on the bureau-top showed the sexual parts intimately united. Still he thought that he might have been deceived by the manner in which their delicate bodies had been crushed together. It was difficult to obtain proof owing to the fact that copulation took place in the air, during rapid

flight, and lasted only a very short time. Convinced of the impossibility of closely studying them in a stationary position he gave up further observation.

However, upon May 13, a lucky chance permitted him to observe what for more than two months had been the object of his research. Seeing a pair of mosquitoes united and hovering in a sun-beam he gently approached them to obtain a better look. Escaping him they flew to the rear of the cabin where, after an irregular flight, they entered the canopy of the bed and alighting remained suspended from the under side of the canopy-top. Here the light yellow color of the cloth contrasted well with the dark bodies of the mosquitoes and this proved to be the long desired opportunity. Waiting until they had become well settled he approached cautiously. The female, recognized by the length and stoutness of her body, sat in the ordinary position of mosquitoes; she clung to the fabric with her front and middle legs, the two hind legs elevated in a half-circle above her wings. The male, on the contrary, had assumed a different attitude. The smaller size of his body and the necessity of obtaining union with the female, who did not seem inclined to incommode herself, left him apparently less at ease. His two greatly elongated front legs alone held him to the top of the canopy while with the other four legs he grasped the female. In spite of their movements, the commander was able to study them well and settle all doubts. An involuntary move on his part, caused by the rolling of the vessel, startled the pair from its resting-place. Still united they tried to obtain a new hold, but without success, and finally flew off and were lost to view, having probably separated.

From his observations Godeheu de Riville concluded that copulation in mosquitoes does not last long, takes place very quickly in comparison with other flies, and appears to occur only in the air. He considers that the attitude assumed does not permit them to alight, and that the one couple thus observed was a rare exception. None of the many other couples which he attempted to observe more closely came to a resting position.

Thus runs the account of Godeheu de Riville. It may be added that this old record furnished the foundation for the statement made by several writers that with the mosquitoes the position in copulation is face to face. From this single observation, like that of the egg-laying habit of *Culex pipiens* by Réaumur, it has been wrongly inferred that such were the habits of the Culicidae in general. More recent

observations, by the writer and others, show that there are two distinct modes of copulation in this family, each correlated with a difference in claw structure in the female. The mode described above obtains in the species in which the claws of the female (first and second, or all three pairs of feet) are toothed. It has been observed in *Stegomyia calopus* by Goeldi and the writer, and in *Aedes varipalpus* by Dr. H. G. Dyar. These, together with the record of Godeheu de Riville, are the only authentic observations known to the writer of this mode of copulation. The other mode appears to be common to all the species in which the female has simple claws. In the case of these copulation likewise takes place in the air but differs strikingly in the relative position of the two sexes. When the two sexes meet in the air they grapple for a moment until union is effected, then, releasing their hold of each other, continue flight united but facing in opposite directions. The heavier female drags the male after her, the longitudinal axes of their bodies forming a straight line. The writer has observed copulation in this manner in *Anopheles punctipennis* and *Culex pipiens*, and Dr. Dyar in *Culiseta consobrinus*.*

With the above data on the mating habits of mosquitoes we can now approach the question of the identity of the species observed by Godeheu de Riville. From the description it is very clear that the species was one in which the claws of the female are toothed. Moreover there are but very few species of mosquitoes that are sufficiently domesticated to breed on board ship. Of all the species with toothed claws *Stegomyia calopus* is the only one that has to any degree associated itself with man, and indeed, as is well known, has been disseminated by shipping throughout the warmer regions of the earth. Another factor that points conclusively to *Stegomyia calopus* is the fact, brought out in Godeheu de Riville's account, that the mosquitoes were most active during the warmest hours of the day, a characteristic habit of this species. There is no other species that conforms with

* Contradictory of these observations, Dr. A. Eysell credits both *Anopheles* and *Culex* with the mode of copulation first described (Archiv f. Schiffs-u. Tropen Hyg., v. 9, p. 51, 1905). In the case of *Anopheles* his statement is credited to the observation of Schaudinn, but I have so far been unable to find the original record. For *Culex* his basis is a note by Grassi on *Culiseta spathipalpis* (Studi di uno zoologo sulla malaria, p. 84, 1900). Dr. Eysell's assertion is evidently based on a misinterpretation, for a careful study of the original text reveals nothing that indicates the relative position of the two sexes.

these requirements: domesticity, character of the toothed claws in the female carrying with it a face to face union of the sexes, and strictly diurnal habits.

Class I, HEXAPODA.

Order V, LEPIDOPTERA.

DESCRIPTION OF THE LARVA OF TORTRICID A FISKEANA DYAR.

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A single larva of this species was found at Tryon, North Carolina, on a *Ceanothus* bush, September 28, 1905. The adult emerged the following year, a female specimen, agreeing in coloration with the male. The larva is structurally a *Lithacodes*, and it will be better to refer the species to that genus, which differs as adult but slightly from *Tortricidia*.

Stage VII. Elliptical, rather elongate, tail subquadrate but not incised on the sides like *fasciola*, not prominent. Dorsum rather over one-third in the dorsal as pect, gently arched, narrowed to the ends; sides oblique, concave, the upper half nearly perpendicular, the lower more oblique to the lateral ridge. Subventral region retracted; head within the hood, which is again within joint 3. Setæ obsolete, very small, without raised tubercles; skin smooth, with rather sparse round clear granules, alike all over, without humps or irregularities even on the lateral ridge. The depressed spaces are without sharp, or even defined edges, the granulation running right across; they are of considerable depth, with the usual glands in the bottom. Dark yellow green, a little suffused with yellow in the dorsal space; a narrow yellow line in the subdorsal ridge, waved, touching depressed spaces (3) at the outcurves of the segmentary arcs, not joining at the ends; a similar but more diffused and rather paler line in the dorsal space, covering depressed spaces (2) at the incurves of the arcs, obsolete at the ends, meeting the subdorsal line intersegmentarily to form a row of dark green ellipses on the upper edge of the subdorsal ridge. A narrow yellow line along the lateral ridge, broken exactly above each spiracle, that is segmentarily posteriorly; no line on joint 3 transversely. Depressed spaces (1) single, annular, yellow, with glandular centers; (2) and (3) smaller, obscured by the yellow bands; (4) with a small yellow dot above and a large arc below, green centered; (5) and (6) in line above the lateral ridge, (5) large, segmentary, (6) small intersegmentary. Length, mature, 8 mm.

Cocoon. Small, rounded, brown, spun in the crevices or under bark. The larva left its plant without much change of color at first, but became pale yellowish on the second day. It wandered about till it encountered some bark, when it constructed its cocoon between two pieces.